Station	Elevation, Meters	Difference in Elevation, Meters	Difference in Anomaly, Subtracting Lower from Higher Station			
			Local Compensation, Dynes	Regional Compensation		
				19 Km., Dynes	59 Km., Dynes	167 Km., Dynes
Mauna Kea, Hawaii..	3,981					
Honolulu, Hawaii	6	3,975	+ .131	+ .118	+ .105	+ .068
Gornergrat, Switzerland	3,016					
St. Maurice, Switzerland	419	2,597	+ .046	+ .041	+ .023	+ .016
Pikes Peak, Colorado	4,293					
Colorado Springs, Colorado	1,841	2,452	+ .028	+ .020	+ .016	+ .012
Yavapai, Arizona	2,179					
Grand Canyon, Arizona	849	1,330	+ .011	+ .010	+ .010	+ .012
Mt. Hamilton, California	1,282					
San Francisco, California	114	1,168	+ .020	+ .020	+ .011	+ .029
Mean anomaly difference			.047	.042	.033	.027
Range in anomaly difference			.120	.108	.095	.056

This is too small a number of pairs to warrant a conclusion, but so far as they go, the results show an advantage for regional compensation. Also in every instance the difference is plus on subtracting the anomaly for the lower station from that for the higher, and there is slight indication of a relation to the difference in elevation. The plus difference, if real, indicates an apparent excess of gravity at the high station as compared with the low station. This may be actual and due to some condition of materials beneath the surface, or it may result from a compensation correction relatively too large being applied to the high station, or from some other feature of the reduction. The evidence given by these pairs of stations is slight, but points to the possibility of further interesting investigation, which might be extended along similar lines to a study of differences of deflections at neighboring astronomic stations.

The conclusions from the above are:

1. From the general mass of results there is practically no evidence showing whether there is nearly complete local compensation or only general regional compensation within the areas considered, that is, within zones up to 167 kilometers (104 miles) radius.

2. The comparison of pairs of neighboring stations differing considerably in elevation shows an advantage for regional compensation, but the number of results is too small for a definite conclusion.

3. The comparison by pairs shows in each case gravity at the higher station in excess as compared with gravity at the lower, which if real, may be due to materials beneath the surface, or to some conditions of the reduction. The number of results, five, is, however, too small for safe general conclusions.

4. If practically identical results are obtained with regional and with local compensation or if limited regional compensation is nearer the truth, it may be possible to lessen the labor of reduction of gravity observations by computing the direct topographic effect and the general compensation for a larger zone about the station.

The above discussion bears on one feature only of the interesting reports to which reference is made.

GEORGE R. PUTNAM

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SPECIAL ARTICLES

THE VALUE OF THE CILIATE, DIDINIUM, IN THE STUDY OF BIOLOGY

Didinium appears only occasionally in ordinary cultures for the protozoa usually studied in the laboratory. Owing to this fact it is not widely known and consequently its exceptional possibilities as laboratory material for study in courses in biology have been quite generally overlooked. I have had this animal under almost continuous observation during the past four years, and have become fairly well acquainted with it. The following notes are based upon these observations.

Didinia feed largely on paramecia. They

multiply more rapidly than paramecia, so that if they are introduced in a culture they soon devour all of their food, after which they ordinarily encyst. In this state they can be kept indefinitely and when wanted for study all that is necessary is to add, a few days in advance, a vigorous culture of paramecia. After the addition of this culture some didinia usually come out within twenty-four hours, but I have found it necessary in some instances to wait several days. They seldom come out in every culture containing cysts, so that it is wise always to keep a number on hand. I have found 50 to 100 c.c. wide-mouthed bottles most satisfactory for this purpose. On several occasions I left culture jars containing cysts together with considerable débris uncovered during the summer vacation and found in the autumn, at least two months after all of the water had evapoated that the cysts came out in about half of the jars. I am, however, of the opinion that the cysts keep better if the liquid is not allowed to dry. On one occasion I kept cysts for very nearly a year[1] in a 5 c.c. bottle full of solution hermetically sealed and found numerous active didinia in less than twenty-four hours after adding a solution containing paramecia. Thus it is evident that after a culture is once established material can be obtained in abundance at any time.

Didinium is usually described as a barrel-shaped organism. It has two bands of cilia, one near the anterior end, which contains a cone-shaped protuberance with the mouth at the apex, the other near the posterior end where the contractile vacuole is located. The so-called seizing organ, a strand of fibrous tissue, extends from the central part of the body to the mouth. The macronucleus is a comparatively large and conspicuous horseshoe-shaped structure. All of these characteristic features can be clearly seen in specimens killed in Worcester's fluid (a saturated solution of corrosive sublimate in ten per cent. formalin containing a little acetic acid) and cleared by adding a very small proportion of ten per cent. glycerine and allowing it to concentrate slowly by evaporation. They can also be seen fairly distinctly in living specimens which have been kept for a day without food, especially if they are held stationary and slightly flattened under the cover-glass. This can be done readily by slowly removing the water by means of a bit of filter paper. If the cover-glass is slightly tapped after the animals are flattened they burst and then the protoplasmic contents flow out. The ectosarc is rather tough and remains intact for some time, resembling a shell. The seizing organ usually breaks up and the numerous fibers of which it is composed separate and flow about in the liquid so that they can be clearly seen. The macronucleus rarely breaks and if the cover-glass is lightly touched at ried about in the more liquid cytoplasm and rolls over and over, presenting a view from all sides. In this way the student gets an exceptionally realistic idea of it as a definite structure having a strikingly different consistency from that of the cytoplasm.

The greatest value of *Didinium,* however, in the study of biology lies in the intense interest aroused by the observation of the remarkable phenomenon of feeding. I have repeatedly seen one of these organisms capture and swallow entire in the course of several seconds a paramecium ten times its own size. And the essentials in this process can readily be observed by almost any student.

I should recommend two different methods in making these observations.

1. Place a good number of didinia which have been without food for a day in a shallow watch-glass or on a slide and then while observing under the low power, add a drop of solution containing numerous paramecia. Or if more details are desired make on a slide, with a small ridge of vaseline, an enclosure somewhat smaller than a cover-glass. The enclosure should have a small opening on one side. Put a large number of hungry didinia

[1] Since writing this I obtained a good number of active didinia from cysts which had been in a 5 c.c. vial full of solution two years and four months.

in the enclosure, cover them with the coverglass, place a drop of solution containing paramecia at the opening in the enclosure, and then study the process of feeding under low or high power at the place where the two solutions meet. Didinia thus enclosed can be studied for hours without danger from drying and if put into a damp chamber when not in use they can often be kept for days. This is an excellent method for observation on all sorts of protozoa.

2. A few seconds after adding paramecia to a solution containing many didinia kill them suddenly by flooding the dish with a liberal supply of Worcester's fluid. If the animals are killed at just the right time specimens in all stages of the process of feeding will be found. These can be mounted and studied at leisure under any magnification desired. If the animals are treated with glycerine as described above the different structures stand out very distinctly. I used this method in demonstrating the protective function of the trichocysts. In order to do this it is, however, necessary to have relatively large paramecia and small didinia.

Another very interesting and instructive process that can be observed readily in *Didinium* is encystment. Although this is a protective process of the greatest importance in many organisms, it is rarely studied first hand. Didinia can be induced to encyst almost any time by cutting off the food supply and adding considerable decaying organic matter, and as previously stated they can be induced to develop and become active again by adding a strong culture of paramecia. Different stages in these processes can frequently be seen, as for example the disappearance of the cilia, mouth seizing-organ, macronucleus, etc.

Conjugation occurs abundantly at times in *Didinium,* but the environmental factors necessary to induce it have not as yet been ascertained with sufficient accuracy to make this form at all favorable for the study of this process. Fission, on the other hand, occurs more frequently than in *Paramecium* and many other protozoa and the essential features in the process are easily worked out.

It seems to me then that owing to the readiness with which *Didinium* can be procured at any time, the ease with which its structures can be worked out, and the possibility of observing the phenomena of fission and encystment and especially the marvelous process of feeding, this animal should become as familiar in biological laboratories as *Paramecium* now is. In fact, the study of *Paramecium* must be regarded as very superficial indeed without observations on *Didinium* and its method of protection against this deadly enemy.

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S. O. MAST

JOHNS HOPKINS UNIVERSITY

THE NUMBERS OF INSECTS DESTROYED BY WESTERN MEDDOWLARKS (STURNELLA NEGLECTA)

Little definite data as to the exact numbers of insects destroyed by birds in a given locality has as yet been available. In connection with an investigation into the food habits of certain California birds now being carried on by the California State Board of Fish and Game Commissioners, and the University of California, considerable evidence as to the toll of insects taken by certain species of birds is being made available. With the help of the deputies of the commission it has been possible to collect birds in sufficient quantities for stomach examination, in some twenty different parts of the state, and in every month of the year. A knowledge of the food habits of the birds throughout the year is therefore at hand.